No. 146 BULLETIN OF THE OHIO STATE UNIVERSITY AGRICULTURAL COLLEGE EXTENSION SERVICE REVISED JUNE, 1939

ERADICATING CANADA THISTLE

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CANADA THISTLE is commonly regarded as the most serious weed pest in Ohio. Canada thistle forms running rootstocks or "roots" which send up new shoots at a distance from the parent plant. Consequently, Canada thistles grow more or less in patches, while the plants of other thistles commonly found in Ohio stand singly. Many small purplish flower heads are borne at the top of each plant.

Are There Different Varieties of Canada Thistle?—There are at least two distinct varieties of Canada thistle in Ohio. One variety (Fig. 1) has

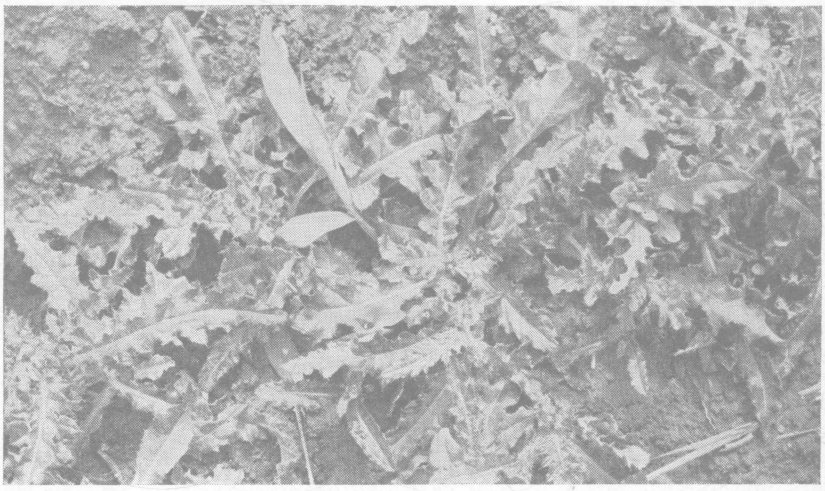


Fig. 1.—Corn in distress. Hard work alone will save it.

very prickly leaves and rarely grows over 3 feet high. This variety is the common one of northern Ohio.

The other variety is found in denser patches, grows 3 to 6 feet tall, has fewer spines on the leaves, and has nearly flat leaves which are whiter beneath (Fig. 3). This type is more common in central and southern Ohio than the short spiny one. It has not been harder to eradicate. This tall variety has been incorrectly called Russian thistle. True Russian thistle is uncommon in Ohio, and does not persist when introduced. It does not resemble Canada thistle.

THE OHIO STATE UNIVERSITY, COOPERATING WITH THE U. S. DEPARTMENT OF AGRICULTURE, AGRICULTURAL EXTENSION SERVICE, H. C. RAMSOWER, *Director*, Columbus, Ohio
FREE—Cooperative Agricultural Extension Work—Acts of May 8 and June 30, 1914

How is Canada Thistle Introduced and Spread?—Canada thistle is generally introduced into a community as an impurity in farm seeds. Once introduced, it may spread by seed or by rootstocks. The seed may be carried by the wind for some distance from the parent plant. The outward growth of the undisturbed patch may be several feet a year. If the patch is plowed through, the rootstocks may be carried by the plow, harrows, or cultivators, and new patches started. In large fields, it is often noticeable that new areas are in a direct tillage line with an old patch.

Does Canada Thistle in Ohio Produce Seed That Will Grow?—It is often said that Canada thistle does not produce seed in central and southern Ohio, or, if seed is produced, it will not grow. *Neither of these statements is correct.* Seeds that would grow are found in southern Ohio, practically every year (see Fig. 2).

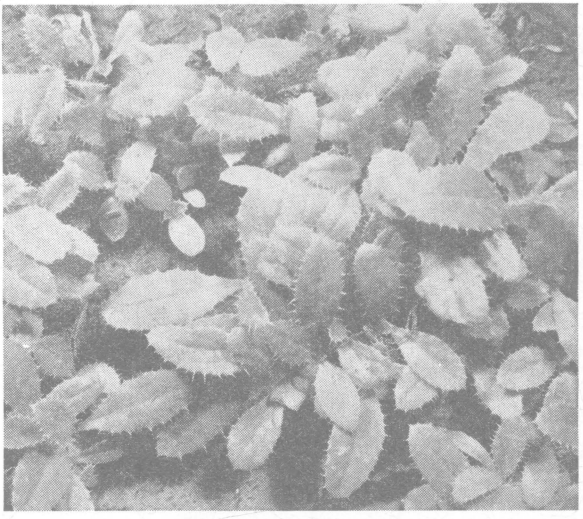


Fig. 2.—Canada thistles do produce seed that will grow! These seedlings were grown in 1932 from seed harvested in Fayette County, Ohio, in 1931.

The ripening of seed heads in any thistle patch is a menace, though there may be some years in which seed is not produced. Of course, shriveled remnants of undeveloped embryos will not grow, but any of the plump, shiny brown seeds found in the heads of Canada thistles probably will grow.

How May Canada Thistles be Controlled and Eradicated?—To control and eradicate Canada thistle, *seed formation must be prevented* and the *rootstocks* of existing plants *must be removed* or *destroyed.*

In planning for control, there are several significant facts to be taken into account. Canada thistle is a persistent weed because of the fleshy rootstocks, in which reserve food materials are stored, making possible the repeated growth of new shoots from each rootstock, if the shoots first formed are cut. During May, these food materials in the rootstocks are used rather rapidly to produce new growth, so that the rootstocks of an undisturbed patch are weakest just before the plants bloom in June. From that time on, and earlier in dry seasons, food materials are stored, and, if the patch is not cut, the rootstocks contain the most stored food in the fall. Canada thistles start rather late in the spring, so that early growing crops such as alfalfa, rye, and wheat overgrow them (Fig. 3).

Successful methods of eradication utilize these facts. The effective

methods listed below may also be combined in many ways. Those suggested for small areas are usually more costly per unit of area, but also more effective.

Control Methods for Large Areas

Repeated Mowing.—Canada thistles make a vertical growth with few basal leaves, so that mowing removes practically all of the leaf area. If this is done several times a season, year after year, the root reserves will be greatly depleted, and the patch may be killed. Killing by repeated mowing is most likely to occur during a succession of wet years, favorable for vigorous top growth but less favorable for the storage of food in the fleshy roots. Usually, however, repeated mowing will merely check, not destroy, Canada thistle. It is one of the best treatments to use in a pasture. The first mowing in the year should be made about June 1, or just before the thistles come in bloom. Later mowings should be made at 4- to 6-week intervals. No experiment known to the authors has given any indication of "magic dates" for cutting thistles.

Succession of Cultivated Crops.—If one does not wish to lose the use of the land, and the thistle patches are not too vigorous, two or three years' careful tillage of cultivated crops, like corn, may be used to eradicate Canada thistle. The ground should be cultivated frequently after the crop is planted, not only until the usual time of "laying by," but all summer. After the corn is cut the thistle area should be worked *until freezing weather.* Each cultivation should be supplemented by hand hoeing to cut any thistles missed in cultivating. The same program should be followed the next year. Two years of this thorough cultivation will eradicate the pest.

Summer Fallowing Followed by Cultivated Crop.—In order to avoid the large amount of hand work involved in the preceding plan, especially if the patches are vigorous, the cultivated crop may be preceded with a year of fallow. It is well to start in the clover year of a corn-wheat-clover or similar rotation. The thistle patches should be allowed to grow until about June 1, then either plowed at once or mowed and plowed later. The plowed area should be cultivated with special deep-running "duckfoot" shovels, or disked thoroughly, at 2- to 3-week intervals until freezing weather. Next spring the area should be well prepared for corn and the corn carefully cultivated and hoed, but there will be little hand work needed compared to starting without a summer fallow. However, if *that hand work to get the last thistle is not done, the whole effort is largely wasted.*

Summer Fallowing Followed by Wheat or Rye.—After summer fallow as just described, wheat or rye may be sown with a liberal application of fertilizer. The early heavy growth of the wheat the next spring will have a severe smothering effect on the slow-starting thistles (Fig. 3). Applying 100 pounds per acre of sulphate of ammonia in April will add to this effect. If the patches are not eradicated by wheat harvest, the infested area may be plowed and worked this second summer, following either with wheat again or with rye and vetch to be plowed down for corn.

Alfalfa as a Smother Crop.—On land adapted to alfalfa, one of the most effective means of fighting thistles is to sow the field to alfalfa, using

every precaution to obtain a vigorous stand. The vigorous competition of the alfalfa and the frequent cutting will always weaken, and may destroy, the thistles. In the spring, alfalfa starts much earlier than Canada thistle (Fig. 3) and the dense shade weakens the thistles. If not entirely eradicated by the alfalfa, a year of corn intensively cultivated and hoed as described above will finish the patch. Where the thistles are in dense patches, they should be weakened before sowing alfalfa, either by plowing in late May or early June and working the land until midsummer before seeding the alfalfa, or by summer smother crops as described below, seeding the alfalfa the following spring.

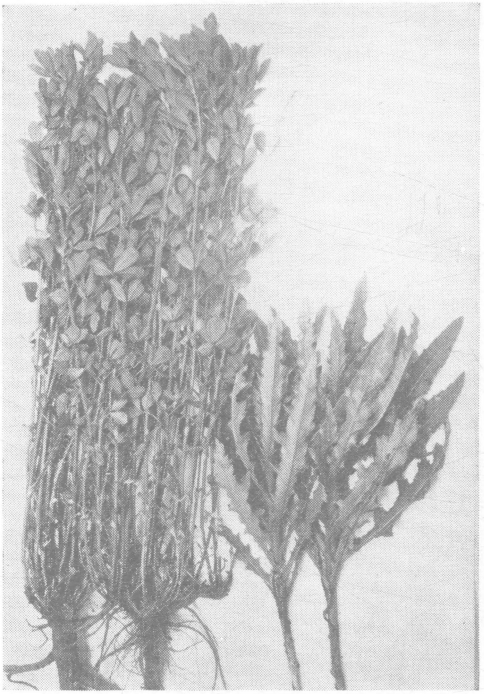


Fig. 3.—Relative height of Canada thistle and alfalfa, May 15.

Summer-growing Smother Crops.—Rapid-growing summer crops, such as soybeans, Sudan grass, sorghums, or sunflowers can be used to eradicate Canada thistle. These crops should not be sown until June, so that the ground may be plowed about June 1 and thoroughly worked before they are planted. These crops should be planted thick, well fertilized, and removed in time to permit planting of wheat or more working of the soil in the fall.

Control Methods for Small Areas

To prevent the further spread of thistles, small areas must be promptly eradicated. Digging out of rootstocks, repeated hoeing, smothering of the plants, or chemical applications are applicable to these small areas.

Digging of Rootstocks.—Occasional scattered plants may be eliminated by digging out the roots. Where pieces of the rootstocks are missed, new sprouts will come up and digging must be repeated.

Smothering.—Covering a patch with tar paper, lapped at least 4 inches and the joints held down with earth, will kill the thistles in one growing season. Placing a straw pile on a thistle patch is only occasionally successful. Usually some of the thistles grow up through the straw at the edges of the pile.

Chemical Applications.—Numerous chemicals have been tried for eradicating noxious weeds. At present, sodium chlorate, alone or in various mixtures, is the most practical and effective chemical to use on small areas of noxious weeds. Nevertheless, the following points should be emphasized:

1. Eradication of Canada thistle with sodium chlorate will cost 25 to 50 cents a square rod. Chlorate mixtures may be even more expensive.

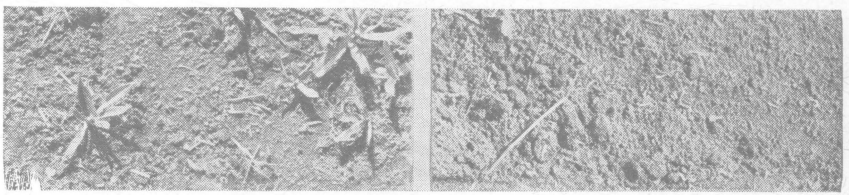
2. More than one application is usually required for eradication. It is folly to use chlorates without definitely planning for additional applications. Experiences with nearly 1500 experimental plots show that occasional areas have been eradicated at one application, many areas with two applications, but that many areas have required three applications (Fig. 4).

3. CHLORATES ARE SERIOUS FIRE HAZARDS IF NOT PROPERLY HANDLED. FOLLOW THE PRECAUTIONS GIVEN ON PAGE 8.

HOW TO USE CHLORATES

*In what Form may Chlorates be Purchased?**—Sodium chlorate is sold as a nearly pure salt; it is also available in a sodium chlorate limestone mixture, especially manufactured for applying chlorates in the dry form. A mixture of sodium chlorate with calcium chloride and other ingredients is also available.

Generally, the effectiveness of these mixtures is in proportion to their chlorate contents, and applications should be adjusted approximately as shown in Table 1.



ONE APPLICATION TWO APPLICATIONS

Fig. 4.—Effect of second application of chlorates. Adjacent portions of same patch; each received sodium chlorate June 19; the right plot received a second application July 31. Picture taken the following May.

Table 1. Equivalent Applications of Chlorate Materials

MATERIAL	POUNDS PER SQUARE ROD			POUNDS PER ACRE		
Sodium chlorate	1½	2¼	3	240	360	480
Sodium chlorate (75%) limestone mixture	2	3	4	320	480	640
Sodium chlorate (60%) calcium chloride mixture	2½	3¾	5	400	600	800

*What is the Best Form of Chlorates to Use?**—Since the development of a fine-textured, non-caking, drillable sodium chlorate limestone mixture, applications in the dry form are to be preferred. This mixture can be applied readily by hand, with a broadcaster, or through the fertilizer attachment of a grain drill. This direct application is far less laborious than preparing and applying chlorates as spray.

* A nearly pure sodium chlorate, finely ground and specially treated to prevent caking, has recently been put on the market. If this proves to be satisfactorily non-caking, it should replace the chlorate-limestone mixture. It will be less expensive than any of the mixtures, and may be used either dry or in solution as desired.

Recommended Systems of Using Chlorates.—Experiment and farm practice suggest two convenient systems of using chlorates on Canada thistles.

System A: Applications Starting in the Summer—

1. Mow the thistles just before the flower buds begin to open—usually early in June.
2. As soon as 4 to 5 inches of new growth has taken place, apply 3 to 4 pounds of sodium chlorate limestone mixture per square rod, or 480 to 640 pounds per acre. (See Table 1 for equivalent amounts of other materials.)
3. If and where new sprouts appear following the first application, the following procedures are recommended:
   (a) If sprouts appear generally over the area, make a second application of 2 pounds of sodium chlorate limestone mixture per square rod, or 320 pounds per acre.
   (b) If only occasional sprouts appear after the first or second broadcast applications, then treat by "spotting" an area at least 1 foot in diameter around each sprout.

System B: Applications Starting in the Fall—

The most generally reliable method of using chlorates on Canada thistle is the following:

1. Mow the patch about June 1 and at least two more times during the summer.
2. In September, October, or November, apply the sodium chlorate limestone mixture at the rate of 3 to 4 pounds per square rod, or 480 to 640 pounds per acre.
3. If sprouts appear the following spring or summer, make additional applications as suggested under 3 (a) and (b) of System A.
4. However, if the treated area is planted the next year to corn or other cultivated crop, the *final* chlorate treatment may be economically delayed until cultivation has been given a chance to clean up the few remaining sprouts. This may often save a second treatment with chlorate.

Applying Chlorate

How May Non-caking Chlorates or Mixtures be Applied?—Broadcasting by hand is the simplest method for areas of a few square rods or less. The material is not caustic. Care must be taken to obtain a uniform application. For "spotting" small areas around isolated sprouts, a fruit jar with a perforated metal top makes hand distribution rapid and convenient.

How are Chlorate Solutions Prepared and Applied?—The solution is readily prepared by hanging the weighed amount of chlorate in a sack at the *top* of the required amount of water. It will dissolve in 15 minutes to an hour, faster if stirred. The recommended strength is 1 pound of chlorate to 1 gallon of water. The rates of application should be equivalent (Table I) to those recommended in systems A and B for the chlorate limestone mixture.

The solution may be put on with any kind of sprayer—a 3-gallon compressed air sprayer for small areas, a barrel sprayer or an orchard sprayer for

larger areas. A sprinkling can may be used for small patches, although it is hard to get a uniform distribution of the solution with it.

Large Top Growth is a Hindrance!—Despite statements to the contrary, a large top growth when chlorates are applied is neither necessary nor desirable. If the growth is so large that it interferes with application it may be cut and removed without decreasing the effectiveness of the chlorate. The greater success of applications after considerable growth in the spring is due to the weakened condition of the rootstocks (see page 2). The following facts have been repeatedly demonstrated: (1) to eradicate weeds having rootstocks like Canada thistle, *a killing concentration of chlorate must be established around the storage roots;* (2) the effectiveness of chlorates is due to their high toxicity, rapid penetration into the soil, and slow decomposition; and (3) chlorates, in killing quantities, are not ordinarily transported within the plant from the leaves to the roots.

The tops of Canada thistles may be killed by relatively small amounts of chlorate, but much greater amounts are required to kill the roots. If the tops are repeatedly killed by light applications, the roots will finally be exhausted and the patch killed, but a heavy initial application, followed by prompt and liberal second or third applications, have been as economical of chlorates and more economical of time than the repeated light applications.

How Does Weather Affect the Action of Chlorates?—If there is little or no rain after applying chlorate, it may not be carried down through the soil to the roots; on the other hand, very heavy rainfall may leach it below the roots of shallow-rooted plants.

Chlorates are more effective when applied in September, October, or November rather than on hot, dry soils in summer. Soils in the fall are generally sufficiently moist to permit rapid penetration of the chlorates to the roots and cool enough to slow up decomposition of the chlorates before they reach the roots.

Pitfalls in the Use of Chlorates

Dissatisfaction with chlorates as weed eradicators may be generally traced to poor methods of application, inadequate amounts, and failures to make a required second or third application (Fig. 4). A part-way attempt to eradicate Canada thistles results in tribulation to the spirit as well as an entire loss to the pocketbook. The weak, sickly sprouts which appear after treatment sometimes die if they are left alone and not re-treated, but more often they become healthy and the work must all be done again. It is far safer to apply chlorates again as soon as any sprouts have made some growth. It is much more economical to make one application too many than one too few.

What Part of a Thistle Patch is Hardest to Kill?—The Edge. All chlorate applications should extend 3 to 4 feet beyond the last visible sprouts in order to kill the roots which may have grown beyond them. There is a tendency to apply more chlorate where the plants are thicker; yet it requires the same amount of chemical per unit area to kill the roots, whether the sprouts are thinly or thickly distributed.

Other Effects of Chlorates

Will the Application of Chlorates Injure the Soil?—Not permanently; but in this climate, profitable crops are not likely to be produced for a year after the last application of chlorates. The injurious effect seems to persist longer on light-colored heavy soils, deficient in organic matter, than on dark-colored soils containing considerable organic matter. The injury to the soil has persisted two and three years on some light-colored heavy soils in this state.

Is Sodium Chlorate Poisonous to Stock?—Not in the quantities they will usually obtain from eating chlorate-treated herbage. Up to ½ pound of sodium chlorate has been experimentally given as a drench to mature horses and cattle without injury. Since salt-hungry stock sometimes eat treated herbage because of its salty taste, it is desirable to be sure that livestock have had plenty of salt before treating areas in an occupied pasture.

Why Not Use Common Salt?

Since common salt has a serious puddling effect on heavy soils and its weed-killing value is hardly one-fortieth that of the chlorates, its use cannot be recommended.

Natural Enemies of Canada Thistle

Canada thistle has several natural enemies. This fact raises false hopes of easy eradication. None of them has definitely been reported to have *eradicated* a patch of thistles. The caterpillars, or larvae, of the painted lady butterfly feed on Canada thistle, and in some years may entirely defoliate patches over large areas. Another crop comes up, however, and the patches are not permanently injured.

At least two species of insects work on Canada thistle heads, and several others on the stems, but they are not of practical importance in controlling it.

There is also a rust disease which often kills the first top growth of the thistles, but has not been known to kill the roots.

When Using Chlorates and Chlorate Mixtures

1. Buy chlorates and chlorate mixtures in the manufacturer's original drums. Store them in these containers *in a detached outbuilding.*
2. Use *metal containers* for chlorates and chlorate solutions.
3. *Do not spill* the dry chlorates or the solution *on floors, wagon beds,* or *anything burnable.*
4. Wear *rubber boots* when applying chlorates.
5. *Do not smoke* or *come near any fire* while applying chlorates.
6. *Remove chlorates* from utensils or equipment at once after making applications.
7. *Wash thoroughly,* or *destroy at once,* clothing or cloths which have been soaked with the chlorate solution, or filled with dry chlorates.
8. Until after a heavy rain, *chlorate treated areas* are a fire hazard both from spontaneous and accidental ignition. See that an accidental "burning-off" of such an area cannot spread to buildings or dry crops.